Course Title: Digital Signal Processing
Date: Jan 17, 2015 (First term)

Course Code: CCE3116
Allowed time: 3 hrs

Year: 3rd
No. of Pages: (2)

Remarks: (answer the following questions... assume any missing data)

Problem number (1) (16 Marks)

(a) Check whether the following systems are static, linear, shift invariant, causal, and stable. **Explain your answer.** **(10 Marks)**

(i) $y_1(n) = x^2(n)$

(ii) $y_2(n) = \cos(x(n))$

(b) Consider the discrete-time sequence $x(n)$ which is periodic every 6 samples: **(6 Marks)**

$$x((n))_6 = \{2, -1, 0, 1, 3, -2\}$$

Find the circular shift:

(i) $x((n-2))_6$
(ii) $x((n+2))_6$
(iii) $x((-n))_6$
(iv) $x((2-n))_6$

Problem number (2) (14 Marks)

(a) Find the inverse Z-Transform of the following functions: **(8 Marks)**

(i) $X(z) = \dfrac{Z^2+0.5Z+1.5}{(Z^2-1.5Z+0.5)}$

(ii) $X(z) = \dfrac{Z(Z+0.5)}{(Z-0.1)^2(Z-0.6)}$

(b) Find Z-Transform and ROC for the following sequences: **(6 Marks)**

(i) $x_1(n) = n(0.5)^n$
(ii) $x_2(n) = (0.2)^n e^n$

Problem number (3) (16 Marks)

(a) Compute the linear convolution, $y(n) = x(n) * h(n)$, where **(6 Marks)**

$$x(n) = \{1, -1, 2, 2\} \quad , \quad h(n) = u(n) - u(n-3)$$

(b) Determine the 4-point DFT of the following sequence: **(6 Marks)**

$$x(n) = \{-1, 2, 2, -1\}$$

Sketch the magnitude and phase of the result 4-point DFT

(b) Find the IDFT of X(k) : (4 Marks)

$$X(k) = \{6, -2 + j2, -2, -2 - j2\}$$

Problem number (4) **(24 Marks)**

(a) A difference equation describing a digital system is given by:

$$y(n) + 0.5y(n-1) = 2(0.8)^n u(n)$$

(i) Solve the difference equation to find $y(n)$. (3 Marks)
(ii) Find the initial and final values of the system response $y(n)$. (2 Marks)
(iii) Check the system stability. (2 Marks)

(b) State the difference between the FIR filter and IIR filter. (2 Marks)

(c) Consider the filter transfer function, (6 Marks)

$$H(z) = \frac{(1 + 2Z^{-1} + Z^{-2})}{(1 + Z^{-1})(1 - 0.5Z^{-1})(1 + 2Z^{-1})}$$

Draw

(i) Direct form I (ii) Direct form II (iii) Parallel form

(d) Design a second order digital high pass filter with cutoff frequency of 2π rad/sec and sampling rate of 4Hz. (6 Marks)

(e) Consider the transfer function of an analog filter, (3 Marks)

$$H(S) = \frac{(S + 0.5)}{(S^2 + 3)}$$

Use bilinear transformation to design the corresponding digital filter (T=1 Sec).

Good luck

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$x(n)$	$X(z)$
$\delta(n)$	1
$(a)^n$	$\frac{z}{z-a}$
$u(n)$	$\frac{z}{z-1}$
e^{-an}	$\frac{z}{z-e^{-a}}$
n	$\frac{z}{(z-1)^2}$